

FLUORINE

FXX

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Liquefied gas Clear to yellow Very irritating odor
	Liquid sinks and boils in water. Poisonous visible vapor cloud is produced.
<p>KEEP PEOPLE AWAY. AVOID CONTACT WITH LIQUID AND VAPOR. Avoid inhalation. Wear chemical protective suit. Evacuate area in case of large discharge. Notify local health and pollution control agencies. Protect water intakes.</p>	
Fire	<p>Not flammable. WILL CAUSE FIRE AND REACT VIOLENTLY WITH COMBUSTIBLES. POISONOUS GAS IS PRODUCED IN FIRE. Wear chemical protective suit with self-contained breathing apparatus. Combat fires from behind barrier, with unmanned hose holder or monitor nozzle. Cool exposed containers with water.</p>
Exposure	<p>CALL FOR MEDICAL AID. VAPOR POISONOUS IF INHALED. Irritating to eyes. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>LIQUID Will burn skin and eyes. Will cause frostbite. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. DO NOT RUB AFFECTED AREAS.</p>
Water Pollution	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>

1. CORRECTIVE RESPONSE ACTIONS

Dilute and disperse
Stop discharge

2. CHEMICAL DESIGNATIONS

- 2.1 CG Compatibility Group: Not listed.
- 2.2 Formula: F₂
- 2.3 IMO/JUN Designation: 2.0/1045
- 2.4 DOT ID No.: 1045
- 2.5 CAS Registry No.: 7782-41-4
- 2.6 NAERG Guide No.: 124
- 2.7 Standard Industrial Trade Classification: 52225

3. HEALTH HAZARDS

- 3.1 **Personal Protective Equipment:** Tight-fitting chemical goggles; special clothing, not easily ignited by fluorine gas.
- 3.2 **Symptoms Following Exposure:** Severe burning of eyes, skin and respiratory system. The burns may develop slowly after exposure.
- 3.3 **Treatment of Exposure:** Flush all affected parts with water for at least 15 min. Do NOT use ointments. Administer artificial respiration and oxygen if required.
- 3.4 **TLV-TWA:** 1 ppm
- 3.5 **TLV-STEL:** Not listed.
- 3.6 **TLV-Ceiling:** 2 ppm
- 3.7 **Toxicity by Ingestion:** Not pertinent
- 3.8 **Toxicity by Inhalation:** Currently not available.
- 3.9 **Chronic Toxicity:** Severe burns may develop slowly after exposure.
- 3.10 **Vapor (Gas) Irritant Characteristics:** Vapors cause severe irritation of eye and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.
- 3.11 **Liquid or Solid Characteristics:** Severe skin irritant. Causes second- and third-degree burns on short contact and is very injurious to the eyes.
- 3.12 **Odor Threshold:** 0.035 ppm
- 3.13 **IDLH Value:** 25 ppm
- 3.14 **OSHA PEL-TWA:** 0.1 ppm
- 3.15 **OSHA PEL-STEL:** Not listed.
- 3.16 **OSHA PEL-Ceiling:** Not listed.
- 3.17 **EPA AEGL:** Not listed

4. FIRE HAZARDS

- 4.1 **Flash Point:** Not flammable
- 4.2 **Flammable Limits in Air:** Not flammable
- 4.3 **Fire Extinguishing Agents:** Not pertinent
- 4.4 **Fire Extinguishing Agents Not to Be Used:** Do not direct water onto fluorine leaks.
- 4.5 **Special Hazards of Combustion Products:** Toxic gases generated in fires involving fluorine.
- 4.6 **Behavior in Fire:** Dangerously reactive gas. Ignites most combustibles.
- 4.7 **Auto Ignition Temperature:** Not flammable
- 4.8 **Electrical Hazards:** Not pertinent
- 4.9 **Burning Rate:** Not flammable
- 4.10 **Adiabatic Flame Temperature:** Currently not available
- 4.11 **Stoichiometric Air to Fuel Ratio:** Not pertinent
- 4.12 **Flame Temperature:** Currently not available
- 4.13 **Combustion Molar Ratio (Reactant to Product):** Not pertinent
- 4.14 **Minimum Oxygen Concentration for Combustion (MOCC):** Not listed

5. CHEMICAL REACTIVITY

- 5.1 **Reactivity with Water:** Reacts with water to form hydrogen fluoride, oxygen, and oxygen difluoride.
- 5.2 **Reactivity with Common Materials:** Reacts violently with all combustible materials, except the metal cylinders in which it is shipped.
- 5.3 **Stability During Transport:** Stable
- 5.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
- 5.5 **Polymerization:** Not pertinent
- 5.6 **Inhibitor of Polymerization:** Not pertinent

6. WATER POLLUTION

- 6.1 **Aquatic Toxicity:** 2.3 ppm*/trout/TL₅₀/fresh water *Time period not specified.
- 6.2 **Waterfowl Toxicity:** Currently not available
- 6.3 **Biological Oxygen Demand (BOD):** None
- 6.4 **Food Chain Concentration Potential:** None
- 6.5 **GESAMP Hazard Profile:** Not listed

7. SHIPPING INFORMATION

- 7.1 **Grades of Purity:** 98%
- 7.2 **Storage Temperature:** Ambient
- 7.3 **Inert Atmosphere:** No requirement
- 7.4 **Venting:** Safety relief
- 7.5 **IMO Pollution Category:** Currently not available
- 7.6 **Ship Type:** Currently not available
- 7.7 **Barge Hull Type:** Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 **49 CFR Category:** Poison gas
- 8.2 **49 CFR Class:** 2.3
- 8.3 **49 CFR Package Group:** Not pertinent.
- 8.4 **Marine Pollutant:** No
- 8.5 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue).....	4
Flammability (Red).....	0
Instability (Yellow).....	3
Special (White).....	W
- 8.6 **EPA Reportable Quantity:** 10 pounds
- 8.7 **EPA Pollution Category:** A
- 8.8 **RCRA Waste Number:** P056
- 8.9 **EPA FWPCA List:** Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 **Physical State at 15° C and 1 atm:** Gas
- 9.2 **Molecular Weight:** 37.99
- 9.3 **Boiling Point at 1 atm:** -306°F = -188°C = 85°K
- 9.4 **Freezing Point:** -362°F = -219°C = 54°K
- 9.5 **Critical Temperature:** -199.5°F = -128.6°C = 144.6°K
- 9.6 **Critical Pressure:** 809.7 psia = 55.08 atm = 5.58 MN/m²
- 9.7 **Specific Gravity:** 1.5 at -188°C (liquid)
- 9.8 **Liquid Surface Tension:** Not pertinent
- 9.9 **Liquid Water Interfacial Tension:** Not pertinent
- 9.10 **Vapor (Gas) Specific Gravity:** Not pertinent
- 9.11 **Ratio of Specific Heats of Vapor (Gas):** 1.362
- 9.12 **Latent Heat of Vaporization:** 71.6 Btu/lb = 39.8 cal/g = 1.67 X 10⁵ J/kg
- 9.13 **Heat of Combustion:** Not pertinent
- 9.14 **Heat of Decomposition:** Not pertinent
- 9.15 **Heat of Solution:** Not pertinent
- 9.16 **Heat of Polymerization:** Not pertinent
- 9.17 **Heat of Fusion:** 244.0 cal/g
- 9.18 **Limiting Value:** Currently not available
- 9.19 **Reid Vapor Pressure:** Currently not available

NOTES

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9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	R E A C T I O N	-305	16.110	-305	0.36850	0	0.192
		-300	21.260	-300	0.47120	25	0.194
		-295	27.590	-295	0.59290	50	0.195
		-290	35.260	-290	0.73540	75	0.197
		-285	44.430	-285	0.90030	100	0.199
		-280	55.280	-280	1.08900	125	0.200
		-275	67.959	-275	1.30200	150	0.202
		-270	82.650	-270	1.54200	175	0.203
		-265	99.509	-265	1.80900	200	0.205
		-260	118.700	-260	2.10400	225	0.206
		-255	140.400	-255	2.42700	250	0.207
		-250	164.699	-250	2.78000	275	0.209
		-245	191.799	-245	3.16200	300	0.210
		-240	221.799	-240	3.57300	325	0.211
		-235	254.799	-235	4.01400	350	0.212
		-230	291.099	-230	4.48500	375	0.213
		-225	330.500	-225	4.98500	400	0.214
		-220	373.399	-220	5.51400	425	0.215
		-215	419.699	-215	6.07100	450	0.216
		-210	469.500	-210	6.65600	475	0.217
		-205	523.000	-205	7.26800	500	0.218
						525	0.219
						550	0.220
						575	0.220
						600	0.221